A Note on Stable Cartels

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Abstract

In noncooperative open membership cartel formation games, it is usually assumed that cartel members will maximize their joint payoffs. Through an example, this note shows that this assumption is problematic, because it imposes some unnecessary restrictions on cartel members' actions. We recommend that the cartel agreement should be endogenously determined in future studies.

Keywords: Cartel formation, stable cartel, self-enforcing agreement
JEL codes: C79, H41

1 Introduction

The noncooperative open membership cartel (coalition) formation model has been widely applied in many economic situations, such as collusion in oligopolistic markets (d'Aspremont et al., 1983; Diamantoudi, 2005), R&D joint ventures (Katz, 1986), international environmental agreements (Barrett, 1994; Finus, 2001), and sharing of natural resources (Miller and Nkuiya, 2016).[1] In a typical application of this model, cooperation among a group of players may potentially create a surplus. However, the existence of externalities and lack of binding agreements may cause free rider problem, which can hinder cooperation and lead to inefficient outcomes.

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[1]See Bloch (2003) for a review.

One possible method to overcome this problem is to form a cartel that regulates its members' actions. Those players that voluntarily choose to be a member will form the cartel and sign a self-enforcing agreement. When payoffs are transferable, a commonly used assumption about the agreement is that all cartel members should coordinate their actions, so as to maximize their joint payoffs. This is a very intuitive assumption, since otherwise the cartel members are likely to renegotiate among themselves to change the agreement so that they could all get larger payoffs.

However, is this a reasonable assumption? To the best of my knowledge, few studies in the literature have considered this question. Through a very simple example, this note shows that this assumption is indeed problematic, because it imposes some unnecessary restrictions on members' actions.

2 An example

Suppose that there is a public good, which may be produced by a set $N = \{1, 2, \ldots, 5\}$ of homogeneous players. Let x_i denote player i's product. Player i's payoff is $u_i = \sum_{i \in N} x_i - \frac{1}{2} x_i^2$, which depends on the total product of the good $\sum_{i \in N} x_i$ and i's individual cost $\frac{1}{2} x_i^2$.

The social welfare is the sum of all players' payoffs $\sum_{i \in N} u_i$, which is maximized when $x_i^* = 5$ for all i. However, each player's dominant product is $x_i = 1 < x_i^*$, regardless other players' actions. This commonly known social dilemma of insufficient provision of public good is mainly caused by the free rider problem.

To overcome this problem, we can form a cartel so as to coordinate its members' actions. Consider a two-stage cartel formation game. In stage one, all players simultaneously decide whether or not to join the cartel. Those choosing to join become cartel members[2]. In stage two, all cartel members coordinate actions to maximize their joint payoffs, while simultaneously non-members choose their own actions.

This game can be solved by backward induction. Suppose that the cartel

[2]This is usually called the open membership rule of cartel formation, since no player can be prevented from becoming a cartel member.

formed in stage one is M, with cardinality $|M| = m$. In stage two, each non-member $j \notin M$ still chooses the dominant product $x_j = 1$. Each member $i \in M$ chooses x_i to maximize $\sum_{i \in M} u_i$, leading to $x_i = m$. Hence, given m, the payoff of a cartel member is $u^C(m) = 5 + \frac{1}{2}m^2 - m$, while the payoff of a non-member is $u^I(m) = 4.5 + m^2 - m$.

We apply the stability concept introduced by d'Aspremont et al. (1983) to predict which cartel will form in stage one. A cartel $M \notin \{\emptyset, N\}$ is said to be stable if $u^I(m) > u^C(m+1)$, and $u^C(m) \geq u^I(m-1)$. Further, N is stable if $u^C(n) \geq u^I(n-1)$, while $\emptyset$ is stable if $u^I(0) > u^C(1)$. A stable cartel is one in which no player has an incentive to unilaterally deviate from his or her participation decision. In our example, the condition for M to be stable is $m = 3$. Therefore, the payoff of a cartel member is $u^C(3) = 6.5$; the payoff of a non-member is $u^I(3) = 10.5$; and the social welfare is $3u^C(3) + 2u^I(3) = 40.5$.

A key assumption in this model is that all members take their actions collectively so as to maximize joint cartel payoffs. We call this the MJP assumption. In our example, this assumption requires each member $i \in M$ to follow a specific agreement in stage two—to produce $x_i = m$ if $|M| = m$.

But is this a reasonable assumption? Let us examine this cartel formation game with the following agreement: each member $i \in M$ should produce $x_i = 0.65m$ if $|M| = m$. Under this alternative assumption, it is easy to verify that the condition for M to be stable is $m = 5$, the payoff of each member is 10.97, and the social welfare is 54.84.

This shows that everyone (including members, non-members, and the social planner who cares about social welfare) will agree to change the cartel agreement from $x_i = m$ to $x_i = 0.65m$. The new agreement is better than the one derived by using the MJP assumption, irrespective of the criterion used to evaluate it. Intuitively, this is because the new agreement is less demanding for cartel members than that based on the MJP assumption,[3] leading to a smaller incentive for players to free-ride on other players' effort. As a result, more players choose to join the cartel and a more efficient outcome is realized.

[3]When $m \geq 2$, $x_i = 0.65m$ is closer to the dominant product $x_i = 1$ than $x_i = m$ is.

3 Discussion

We have shown that the MJP assumption might not be appropriate since, at least under some situations, everyone has an incentive to replace the agreement based on the MJP assumption by a less demanding one. The problem with the former is that it imposes some unnecessary restrictions on members' actions. The members should only care about their payoffs in a stable cartel, instead of those in all possible cartels, which the MJP assumption requires. It is these redundant requirements that undermine the MJP assumption. Hence, the MJP assumption is problematic despite seeming quite intuitive and being widely applied.

Since agreements are not binding, some readers may wonder whether the non-MJP agreement $x_i = 0.65m$ is renegotiation-proof against the MJP agreement $x_i = m$. That is, once the cartel is formed and all players receive their payoffs under $x_i = 0.65m$, will the members have incentives to switch this agreement to the MJP agreement $x_i = m$? In fact, none of the members will choose to do so, since otherwise the payoff of each of them will either decrease from 10.97 to 6.5 (as a member), or decrease from 10.97 to 10.5 (as a non-member).

Another interesting question is whether the new agreement ($x_i = 0.65m$) is "optimal". The point is that an explicit criterion is needed to established whether or not an agreement is "optimal". For future studies, a lesson we can learn from this note is that a cartel agreement should be endogenously determined, rather than exogenously given. Some studies (Carraro et al., 2009; Köke and Lange, 2017; Mao, 2017) have already discussed endogenous agreements in some specific applications, but more work is needed in more general situations.

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